Compound Deposition by Electrochemical Atomic Layer Epitaxy (EC-ALE)

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The work discussed will concern developments in the formation of compound semiconductors using electrochemical atomic layer epitaxy (EC-ALE), the electrochemical analog of atomic layer epitaxy (ALE). ALE is based on the formation compounds a monolayer at a time, using surface limited reactions. An atomic layer of one element can frequently be electrodeposited on a second at a potential under that needed to deposit the element on itself, and this process is referred to as underpotential deposition (UPD). EC-ALE is the use of UPD for the surface limited reactions in an ALE cycle.

The basics of the EC-ALE cycle will be discussed, what elements have been used to form deposits and what compounds have been formed. In addition, the flow deposition hardware and control programs will be described. Issues of present concern are the need for changes in the potentials for the deposition of atomic layers, as the deposit forms.

Presently, studies are underway to form superlattices of InAs/InSb. X-ray diffraction indicates deposits that are very close to the period anticipated from the program. Absorption measurements on the superlattices show them to be red shifted from the lower bandgap material, InSb, suggesting that they are type II superlattices, which is encouraging.

Given that EC-ALE is based on surface limited electrochemical reactions, studies of relevant electrodeposit surface chemistry will be described, and specifically, the formation of Te and Cd atomic layers and the formation of compound monolayers. Studies have been performed using LEED, Auger, XPS, and STM.